SAFE SOLDERING WORK PRACTICES

Hand soldering operations (soldering being defined as a joining process using a filler metal (solder) with a liquidus below 840°or 450°C) may involve the use of products such as solder, fluxes, and cleaning agents. Flux allows the solder to flow more smoothly.

Soldering may present a potential exposure for employees via airborne, skin contact, or hand to mouth routes with either the products themselves or their by-products. To ensure employee awareness of the hazards and safe work practices when working with solder, this summary with suggested resources has been prepared for use by workers and supervisors of soldering operations.

POTENTIAL HAZARDS

Fumes from heated solder constituents: Lead and tin are the constituents of most solder currently used at LBL. The solder composition may vary but is commonly 60-63% tin and 37-40% lead. Other metals may also be found in solder.

Fumes from heating oil, paints, or coatings present on the surfaces heated during soldering: Acrid odors, lead from paint etc…

Fumes from fluxes: Soldering may involve the use of flux paste or liquid, or the solder itself may have a rosin core. When this flux is heated it may be volatilized to a gaseous state. While "fume" strictly speaking refers to volatilized solid material that has then condensed in the air, the term is loosely used to refer to other airborne products including gases and vapors that may be produced in soldering. Flux types can vary.

Rosin fluxes- A large portion of the evolving fumes during soldering comes from the organic solvent used to dissolve the rosin. Aliphatic aldehydes, measured as formaldehyde, have been selected as the best indicator of rosin pyrolysis products (known as colophony). Exposure to colophony can cause occupational asthma. OSHA does not have a current limit for these rosin flux decomposition products, but NIOSH recommends the rosin core flux pyroloysis products be measured as formaldehyde and limited to 0.1 mg/m^3 (for an 8-hour Time Weighted Average exposure). ACGIH recommends the levels be kept as low as possible. There are established OSHA limits for formaldehyde only, and employee exposure should be kept below these limits (TWA 8- hour exposure 0.75 ppm, Action Level 0.50 ppm). The Kester 186 Rosin Soldering Flux (Flux Pen; 36% rosin) and Kester 44 Rosin Flux Cored Solder (<3% rosin) contain rosin.

Organic Water Soluble Fluxes-These intermediate fluxes contain organic salts as amine hydrohalides and organic acids such a citric, lactic, benzoic, and glutamic. These organic acids may produce mild allergic irritation of the skin and respiratory tract while contact with concentrated solutions can cause severe burns to the skin or eyes.

Inorganic Water Soluble Fluxes-These strong fluxes are corrosive and contain zinc chloride, stannous chloride, hydrochloric acid and phosphoric acid dissolved in water. Zinc chloride can cause irritation of the nose, throat, and respiratory tract.

Gases and vapors from cleaning agents: Acids, alkalis, and organic solvents may be used to clean surfaces prior to soldering and for removal of remaining unwanted solder of flux residues after soldering. Hazards should be assessed on an individual basis for the solvents used in each operation.

Burns: Burns can result from touching the hot objects (gun/iron) associated with soldering.

SOLDER CONSTITUENTS – LEAD AND OTHER METALS

Lead and tin are constituents of solders in common use at LBL. Other metals that can be found in solders include cadmium, silver, copper, nickel, zinc, arsenic, beryllium, antimony, indium, and bismuth. If these are used, their hazards should be assessed. Fumes may be a concern with *all* metal constituents.

The OSHA Lead Standard (CFR 1910.1025) addresses worker exposure to lead as an airborne contaminant. Based on standard soldering iron temperatures of 620°F-700°F and the melting point of lead (621°F), with a vapor pressure of 0.0 mm Hg and a boiling point of 3164°F, it is unlikely that an excessive amount of lead fume will be generated during hand soldering unless the solder is heated to extreme temperatures. However, exposure monitoring must still be done to verify the absence of lead fumes. Even when there is no exposure to lead fumes, there is still a need for safe work practices to prevent employee exposure to other soldering constituents.

EXPOSURE ASSESSMENT

Since there can be several products in use during the soldering process, each operation should be evaluated. However in all cases, work should be done in *well-ventilated areas*, and any signs or symptoms of irritation should be immediately reported to your supervisor and Health Services. Lead safe work practices should be followed at all times. Any change in process or materials should be evaluated by the EH&S Industrial Hygiene Group (http://www.lbl.gov/ehs/ih/index.shtml) for potential hazards.

RECOMMENDED LEAD WORK PRACTICES

To prevent the ingestion of lead, hands should be washed with soap and water before breaks, lunch, prior to smoking, at the completion of soldering and at the end of the workday. Work areas should be kept clean and wiped with a damp paper towel to minimize the presence of lead dust in the work area. Food is not permitted in laboratory work areas (See LBL Chemical Hygiene and Safety Plan http://www.lbl.gov/ehs/chsp/index.shtml.)

LEAD TRAINING

Employees who work with lead solder are required to take LBL Training EHS 0329, the Lead Hazards Communication web-based training class. The link for this class is: http://www.lbl.gov/ehs/lead/lead.htm. Employees can take EHS 0330 Lead Hazards Awareness, which is designed for those whose exposure to lead may exceed the OSHA Action Level (complete your JHQ to determine which class is right for you). Questions about the LBL Lead Program should be addressed to **Carole Fried, x2603 (cafried@lbl.gov)**

LEAD FREE SOLDER

Lead's ability to reduce the melting point of tin, increase its strength and improve its ductility, and provide excellent thermal cycling fatigue resistance make the tin-lead alloy unique. While the soldering process based on tin-lead solder does not present immediate airborne lead exposure problems, lead work practices and waste disposal are still an issue. There are environmental and economic advantages to using lead-free solder.

The electronics manufacturing industry is moving towards the use of lead-free solder. Alternatives may be less satisfactory in some ways, and as with any new product, an assessment of hazards should be conducted by EH&S Industrial Hygiene Group (http://www.lbl.gov/ehs/ih/index.shtml) when first introduced and when process changes are made.

?Questions?: Please call Betsy MacGowan ext 2826 or Carole Fried ext 2603.